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PUBLIC NOTICE

FEDERAL COMMUNICATIONS COMMISSION
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Released: __________

NEW ICO PROPOSAL FOR
ANCILLARY TERRESTRIAL COMPONENT TO
2 GHz MSS SERVICE
IB Docket No. 99-81

Pleading Cycle Established

COMMENTS: [30 days after publication in Federal Register]
REPLY COMMENTS: [45 days after publication in Federal Register]

By this Notice, the Commission invites comment on a proposal submitted by New ICO Global Communications (Holdings) Ltd. to the Commission on March 8, 2001.[1] New ICO proposes to modify the Commission's rules to allow 2 GHz MSS licensees to incorporate an "ancillary terrestrial component," or "ATC," into their soon-to-be-authorized MSS networks (the "ATC Proposal").

The ATC Proposal consists of three concise rule changes that define 2 GHz MSS to include not only conventional MSS transmissions, but also ancillary terrestrial re-use of assigned MSS frequencies. New ICO asserts that by authorizing such re-use on an ancillary basis by operational 2 GHz MSS networks, the Commission can remedy signal coverage problems that have plagued the mobile-satellite service, thereby improving service to both urban and rural areas, improving spectrum efficiency, and making possible the complete range of commercial, military, and public safety applications that only MSS networks can provide. New ICO states that the rule changes it proposes would make it possible for all 2 GHz Mobile-Satellite Service operators to integrate ATC into their MSS networks, using any one of at least four possible system architectures. New ICO further states that its proposal would ensure that the terrestrial

[1] Letter from Lawrence H. Williams to Chairman Michael Powell, dated March 8, 2001 ("New ICO *ex parte*").

component of the network remains truly ancillary, by permitting ATC operations only after the space stations in the 2 GHz MSS networks have been placed in commercial service.

The specifics of the ATC Proposal are set forth in the March 8 New ICO *ex parte* and its attachments. We incorporate those documents as part of this Notice, and provide the text in the Appendices. Appendix A contains the narrative portion of the New ICO *ex parte*, advancing proposed amendments to the Commission's rules. Appendix B contains a technical annex prepared by New ICO in support of its proposal and originally attached to the New ICO *ex parte*. Appendix C contains the specific amendments to Part 25 that New ICO proposes.

We seek comment on whether we should adopt the ATC Proposal as requested by New ICO. We also seek comment on whether, in the event we do not adopt the proposal in its entirety, there are any aspects of the proposal that we should incorporate into our rules. We also invite commenting parties to propose alternative plans to that submitted by New ICO.

Ex Parte Presentations. This is a permit-but-disclose notice and comment rulemaking proceeding. *Ex parte* presentations are permitted, except during the Sunshine Agenda period, provided that they are disclosed as provided in Commission rules.[2]

Initial Regulatory Flexibility Analysis. As required by the Regulatory Flexibility Act (RFA),[3] the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities by the policies and rules proposed in this Notice. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided below in paragraph D of this Section. The Commission will send a copy of the Notice, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration. See 5 U.S.C. § 603(a). In addition, the Notice and IRFA (or summaries thereof) will be published in the Federal Register. *See id.* Pursuant to the Regulatory Flexibility Act of 1990, 5 U.S.C. §§ 601–612 (RFA), as amended by the Contract with America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847, the Commission's Initial Regulatory Flexibility Analysis with respect to this Notice is as follows:

Need for and Objectives of the Proposed Rule: This Notice seeks comment on a proposal to allow 2 GHz MSS licensees to include an Ancillary Terrestrial Component ("ATC") into their soon-to-be licensed networks. These actions are necessary for the Commission to evaluate these proposals and seek comment from the public on any other alternatives. The objective of this proceeding is to create rules to authorize 2 GHz Mobile-Satellite Service licensees flexibility to implement spectrum-efficient methods of re-using MSS spectrum terrestrially on an ancillary basis, to improve rural and in-building coverage, increase spectrum efficiency, and promote more competitive MSS network deployment in a manner that serves the public interest. We

[2] *See generally* 47 C.F.R. § § 1.1201, 1.1203, 1.1206.

[3] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 *et seq.*, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

believe that adoption of the proposed rules will reduce regulatory burdens and, with minimal disruption to existing permittees and licensees, result in the continued development of 2 GHz MSS and other satellite services to the public.

Legal Basis: This action is taken pursuant to Sections 1, and 4(i) and (j) of the Communications Act, as amended, 47 U.S.C. § § 151, 154 (i), 154(j), and Section 201(c)(11) of the Communications Satellite Act of 1962, as amended, 47 U.S.C. § 721(c)(11), and Section 553 of the Administrative Procedure Act, 5 U.S.C. § 553.

Description and Estimate of Small Entities Subject to the Rules: The Commission has not developed a definition of small entities applicable to geostationary or non-geostationary orbit fixed-satellite or mobile satellite service operators. Therefore, the applicable definition of small entity is the definition under the Small Business Administration (SBA) rules applicable to Communications Services, Not Elsewhere Classified. This definition provides that a small entity is one with $11.0 million or less in annual receipts.[4] According to Census Bureau data, there are 848 firms that fall under the category of Communications Services, Not Elsewhere Classified which could potentially fall into the 2 GHz MSS category. Of those, approximately 775 reported annual receipts of $11 million or less and qualify as small entities.[5] The rules proposed in this Notice apply only to entities providing 2 GHz mobile satellite service. Small businesses may not have the financial ability to become 2 GHz MSS system operators because of the high implementation costs associated with satellite systems and services. At least one of the 2 GHz MSS applicants may be considered a small business at this time. We expect, however, that by the time of implementation it will no longer be considered a small business due to the capital requirements for launching and operating its proposed system. Since there is limited spectrum and orbital resources available for assignment, we estimate that no more than 8 entities will be approved by the Commission as operators providing these services. Therefore, because of the high implementation costs and the limited spectrum resources, we do not believe that small entities will be impacted by this rulemaking to a great extent.

Reporting, Recordkeeping, and Other Compliance Requirements: The proposed action in this Notice would affect those entities applying for 2 GHz MSS space station authorizations and those applying to participate in assignment of 2 GHz MSS spectrum.

Federal Rules that Overlap, Duplicate or Conflict with Proposed Requirements: None.

Steps Taken to Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered: In developing the proposals contained in this Notice, we have attempted to minimize the burdens on all entities in order to allow maximum flexibility for efficient operations by all participants in the 2 GHz MSS market, regardless of size, consistent with our other objectives. We seek comment on the impact of our proposals on small entities

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4 13 C.F.R. § 121.201, Standard Industrial Classification (SIC) Code 4899.

5 U.S. Bureau of Census, U.S. Department of Commerce, 1992 Census of Transportation, Communications, Utilities, UC92-S-1, Subject Series, Establishment and Firm Size, Table 2D, Employment Size of Firms: 1992, SIC Code 4899 (issued May 1995).

and on any possible alternatives that could minimize the impact of our rules on small entities. In particular, we seek comment on alternatives to the reporting, recordkeeping, and other compliance requirements discussed above. Written comments are requested on this Initial Regulatory Flexibility Analysis. These comments must be filed in accordance with the same filing deadlines set for comments on the other issues in this Notice, but they must have a separate and distinct heading designating them as responses to the Regulatory Flexibility Analysis. The Secretary shall send a copy of this Notice to the Chief Counsel for Advocacy of the Small Business Administration in accordance with Section 603(a) of the Regulatory Flexibility Act.

Deadlines and Instructions for Filing Comments. Pursuant to Sections 1.415 and 1.419 of the Commission's rules, 47 C.F.R. §§ 1.415, 1.419, interested persons may file comments limited to the issues addressed in this Public Notice no later than _________ and Reply Comments no later than _________. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS).[6] Comments filed through the ECFS can be sent as an electronic file via Internet to http://www.fcc.gov/e-file/ecfs.html. In completing the ECFS transmittal screen, parties responding should include their full name, mailing address, and the applicable docket number, _________. Parties who choose to file by paper must file an original and four copies of each filing. All filings must be sent to the Commission's Secretary, Magalie Roman Salas, Office of the Secretary, Federal Communications Commission, 445 12th Street, S.W., Rm. TW-A325, Washington, D.C. 20554. One copy of all comments should also be sent to the Commission's copy contractor. Copies of all filings are available for public inspection and copying during regular business hours at the FCC Reference Information Center, Portals II, 445 12th Street, S.W., Washington, D.C. 20554, telephone 202-857-3800, facsimile 202-857-3805.

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[6] *See Electronic Filing of Documents in Rulemaking Proceeding*, 63 Fed. Reg. 24121 (May 1, 1998).

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APPENDIX B

Intra-System and Inter-System Spectrum Sharing of MSS Networks Including an Ancillary Terrestrial Component (ATC)

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March 8, 2001

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Appendix B:

INTRA-SYSTEM AND INTER-SYSTEM SPECTRUM SHARING OF MSS NETWORK INCLUDING AN ANCILLARY TERRESTRIAL COMPONENT (ATC)

1.0 Introduction

Intra-system spectrum sharing between the Satellite Component (SC) and the Ancillary Terrestrial Component (ATC) of a MSS Network, and inter-system spectrum sharing between that MSS Network and another MSS system operating in an Adjacent Frequency Block (AFB) or out of MSS band (OOMSSB) services, are facilitated by a set of techniques that together allow reuse of 2 GHz MSS spectrum by the ATC. This spectrum sharing is achieved using specific operational methods to mitigate the impact of interference and maintain transparency of services to the user.

- **ATC provides service where it would not normally be efficient to provide MSS.**
- **ATC uses frequencies that would not otherwise effectively be used in that particular location.**
- **ATC coverage in urban areas combined with wide-area SC coverage provides universal service.**
- **The operational methods necessary to successfully reuse spectrum require fully integrated network and spectrum resource management of the SC and ATC of the MSS Network by a single entity.**

2.0 The ATC Concept Allows Reuse of 2 GHz MSS Spectrum By The ATC Providing More Efficient Spectrum Utilization

Terrestrial cellular mobile systems provide high quality service in urban and suburban areas, but are uneconomic in sparsely populated rural areas. Conversely, conventional MSS systems provide high quality service in rural areas, but cannot cope with the shadowing and multipath characteristic of urban and suburban areas.

Some MSS operators, like Iridium and Globalstar, have deployed dual-mode handsets in an attempt to provide high quality service in both urban and rural areas. In this approach, the terrestrial and MSS systems use different spectrum. This is an inefficient use of the valuable spectrum resource, with the MSS spectrum left unused in urban areas, and the terrestrial spectrum under utilized in rural areas.

The ATC concept allows reuse of the MSS spectrum by the ATC in urban areas, while still allowing the SC to utilize the same spectrum to provide service in rural areas. This results in more efficient spectrum utilization.

Table 1 summarizes the four possible modes of intra-system spectrum sharing, Forward Band, Reverse Band, Downlink Duplex, and Uplink Duplex. Each of the four sharing modes has associated interference issues.

Table 1. Possible ATC/SC Sharing Modes

Sharing Mode	SC Uplink Spectrum Shared With	SC Downlink Spectrum Shared With
Forward Band	ATC Return Links	ATC Forward Links
Reverse Band	ATC Forward Links	ATC Return Links
Downlink Duplex		ATC Return Links & ATC Forward Links
Uplink Duplex	ATC Return Links & ATC Forward Links	

2.1. Forward Band Sharing Mode

The Forward Band sharing mode is illustrated in Figure 1. The ATC return links operate in the same spectrum as the SC uplinks, and the ATC forward links operate in the same spectrum as the SC downlinks. There are four potential interference cases (see Figure 1): two between the SC Satellite and the user terminal (UT) operating in the ATC mode (UT 2), and two between the UTs operating in the SC mode (UT 1) and the ATC Base.

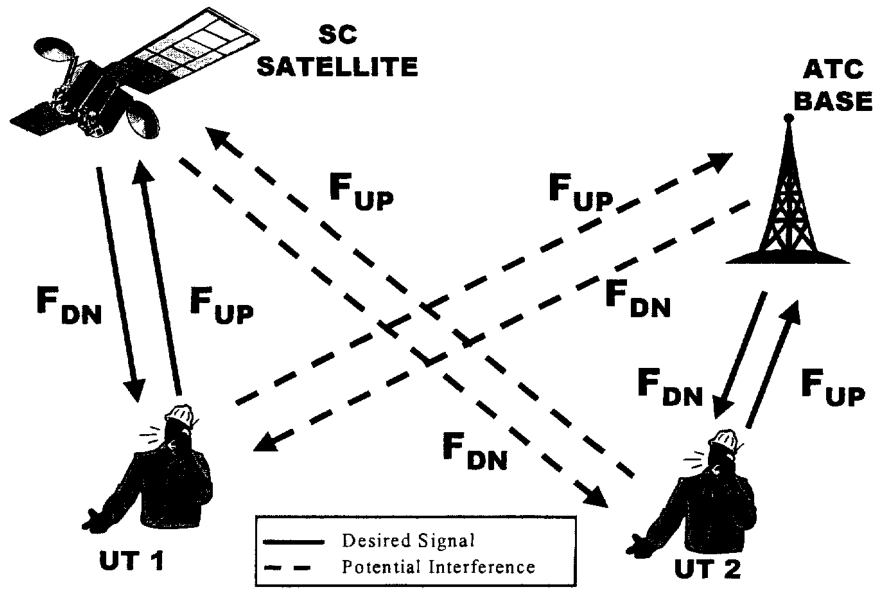

Figure 1. Forward Band Sharing Mode

This potential interference is mitigated by: 1) planning smaller ATC cells than would have been possible with exclusive spectrum; 2) requiring that all UTs are dual mode enabling the implementation of the network and resource management functions described in 3 and 4 below; 3) initially assigning non-overlapping spectrum to SC downlink [uplink] channels and to receive [transmit] channels of UTs operating in ATC mode in areas where the SC beams overlap ATC cells, and then dynamically controlling the number of overlapping channel assignments based on the relative loading between the SC and ATC; and 4) dynamically insuring that uplink [downlink] channels for UTs operating in the SC mode near an ATC Base and receive [transmit] channels of this ATC Base do not overlap.

<u>This combination of techniques effectively mitigates the potential interference, enabling the ATC and SC to share spectrum using the Forward Band sharing mode.</u>

2.2. Reverse Band Sharing Mode

The Reverse Band sharing mode is illustrated in Figure 2. The ATC return links operate in the same spectrum as the SC downlinks, and the ATC forward links operate in the same spectrum as the SC uplinks. There are four potential interference cases (see Figure 2): two between the SC Satellite and the ATC Base, and two between UTs operating in the SC mode (UT 1) and in the ATC mode (UT 2).

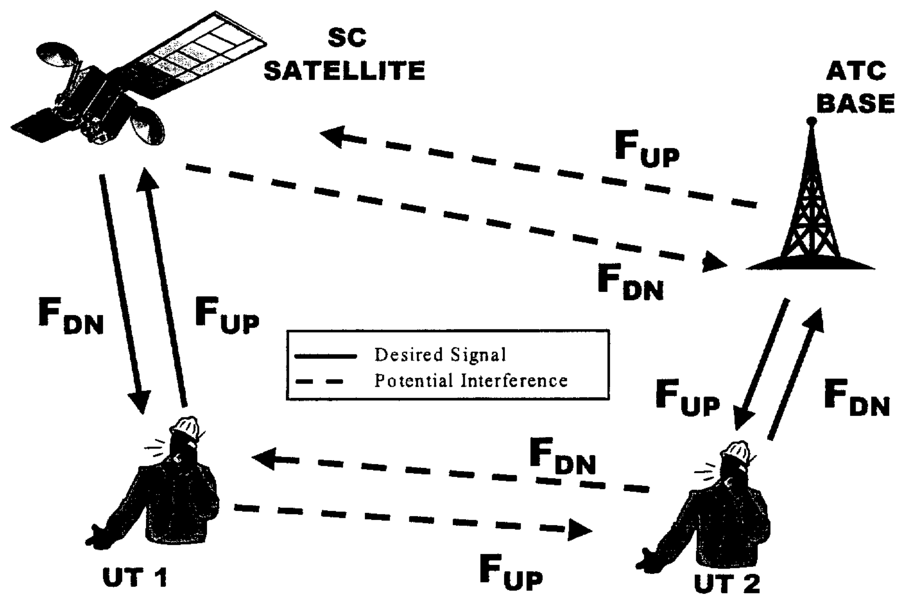

Figure 2. Reverse Band Sharing Mode

This potential interference is mitigated by: 1) designing the ATC Base antennas to minimize gain at angles above the horizon; 2) planning smaller ATC cells than would have been possible with exclusive spectrum; 3) requiring that all UT are dual mode, enabling the implementation of the network and resource management functions described in 4 and 5 below; 4) initially assigning non-overlapping spectrum to SC downlink [uplink] channels and ATC Base receive [transmit] channels in areas where the SC beams overlap ATC cells, and then dynamically controlling the number of overlapping channel assignments based on the relative loading between the SC and ATC; and 5) dynamically insuring that uplink [downlink] frequency assignments for UTs operating in the SC mode near an ATC Base and receive [transmit] channels of this ATC Base do not overlap.

<u>This combination of techniques effectively mitigates the potential interference, enabling the ATC and SC to operate in the same frequency spectrum using the Reverse Band sharing mode.</u>

2.3. Downlink Duplex Sharing Mode

The Downlink Duplex sharing mode is illustrated in Figure 3. The ATC return links and forward links both operate in the spectrum assigned to the SC downlinks. There are four potential interference cases (see Figure 3): from the SC Satellite into the ATC Base and into UT operating in the ATC mode (UT 2); and into the UT operating in the SC mode (UT 1) from the ATC Base and from the UT operating in the ATC mode (UT 2).

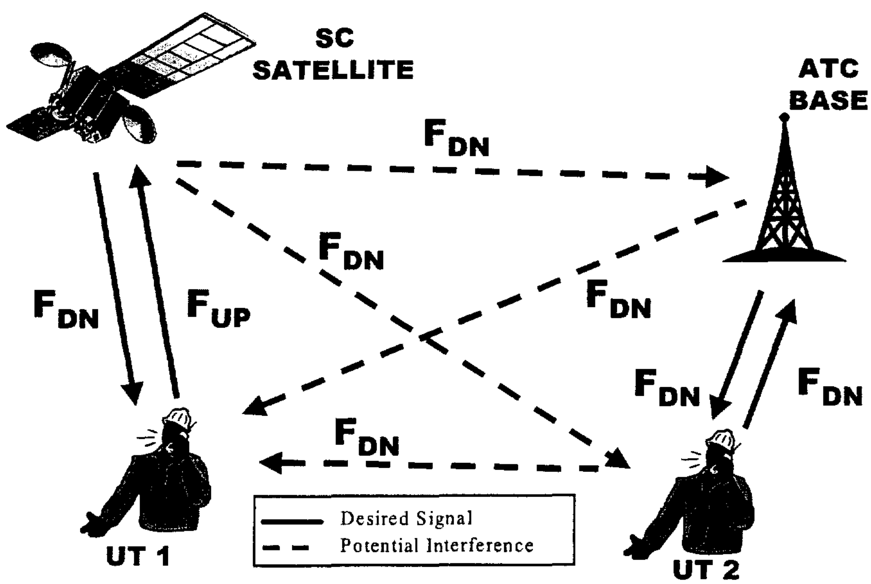

Figure 3. Downlink Duplex Sharing Mode

This potential interference is mitigated by: 1) designing the ATC Base antennas to minimize gain at angles above the horizon; 2) planning smaller ATC cells than would have been possible with exclusive spectrum; 3) requiring that all UTs are dual mode, enabling the implementation of the network and resource management functions described in 4 and 5 below; 4) initially assigning non-overlapping spectrum to SC downlink channels and to the receive channels of UT operating in the ATC mode (UT 2) in areas where the SC beams overlap ATC cells, and then dynamically controlling the number of overlapping channel assignments based on the relative loading between the SC and ATC; and 5) dynamically insuring that SC downlink frequency assignments for UT operating in the SC mode (UT 1) near an ATC Base and transmit channels of this ATC Base do not overlap.

This combination of techniques effectively mitigates the potential interference, enabling the ATC and SC to operate in the same frequency spectrum using the Downlink Duplex sharing mode.

2.4. Uplink Duplex Sharing Mode

The Uplink Duplex sharing mode is illustrated in Figure 4. The ATC return links and forward links both operate in the spectrum assigned to the SC uplinks. There are four potential interference cases (see Figure 4): from the UT operating in the SC mode (UT 1) into the ATC Base and into the UT operating in the ATC mode (UT 2); and into the SC Satellite from the ATC Base and the UT operating in the ATC mode (UT 2).

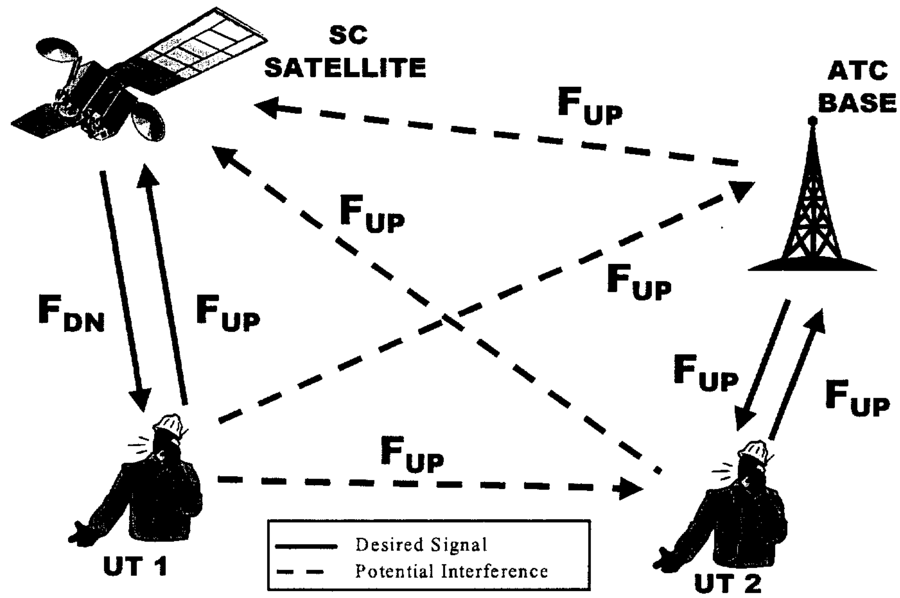

Figure 4. Uplink Duplex Sharing Mode

This potential interference is mitigated by: 1) designing the ATC Base antennas to minimize gain at angles above the horizon; 2) requiring that all UTs are dual mode, enabling the implementation of the network and resource management functions described in 3 and 4 below; 3) initially assigning non-overlapping spectrum to SC uplink channels and to transmit channels of UT operating in the ATC mode (UT 2) in areas where the SC beams overlap ATC cells, and then dynamically controlling the number of overlapping channel assignments based on the relative loading between the SC and ATC; and 4) dynamically insuring that frequency assignments for uplinks of UTs operating in the SC mode (UT 1) near an ATC Base and to receive channels of this ATC Base do not overlap.

<u>This combination of techniques effectively mitigates the potential interference, enabling the ATC and SC to operate in the same frequency spectrum using the Uplink Duplex sharing mode.</u>

<u>The key to mitigating interference and insuring that the SC and the ATC can successfully share spectrum is to have a single entity responsible for fully integrated operation of the MSS Network.</u>

The Commission has adopted a "band arrangement" for the 2 GHz MSS resulting in the 35 MHz of spectrum in each direction (1990 – 2025 MHz uplink and 2165 – 2200 MHz downlink) being divided into segments of equal bandwidth based on the number of proponents at the time the first 2 GHz MSS system is authorized. Depending on the number of authorized systems, the segments could be 3.5 MHz, 3.889 MHz, 4.375 MHz, 5 MHz, or 17.5 MHz wide. **The ATC is fully compatible with any of these segment widths.**

The following sections provide characteristics of typical SC and ATC, and use them to demonstrate that the **SC and ATC can successfully share spectrum**. Then it is shown that **adjacent frequency block (AFB) and out of MSS band (OOMSSB) ATC emissions are acceptable**.

3.0 The ICO Satellite System Is Used As A Representative Satellite Component

The ICO constellation is comprised of 10 satellites in two planes of 5 satellites each, with up to two active spares. The planes are inclined at 45° to the equator, and spaced with 180° separation. The satellites orbit at 10,390 km altitude, and are uniformly spaced in their planes. The coverage parameters are shown in Table 2.

Table 2. Satellite Coverage Parameters

	Satellite Radio Coverage	Nominal Gateway Coverage	Nominal Subscriber Coverage
Elevation Mask	0°	5°	20°
Nadir Angle	22.41°	22.32°	20.99°
Earth Central Angle	67.6°	62.7°	49.0°
Coverage Radius	7524 km	6978 km	5456 km
Earth Coverage	30.9%	27.1%	17.2%

The satellites are designed for a 12-year on-orbit life. They have a wet (launch) mass of 2,750 kg. End-of-life (EOL) solar array output is 8,600 watts, and battery capacity is 250 amp-hours.

The gateway links operate in C-band, uplinks in 5,150 – 5,250 MHz and downlinks in 6,975 – 7,075 MHz. The C-band antennas are footprint coverage. The subscriber links operate in S-band, uplinks in the 1985 – 2015 MHz band and downlinks in the 2170 – 2200 MHz band. These potential operating ranges overlap 25 MHz of the 1990 – 2025 MHz US allocation for 2 GHz MSS service uplinks and 30 MHz of the 2165 – 2000 MHz US allocation for 2 GHz MSS service downlinks.

The satellites have separate S-band transmit and receive active phased array antennas. The payloads perform narrowband DSP based channelization, routing, and beamforming of 490 channels. These channels can be placed in any of 200 frequency channels in any of 163 beam locations (see Figure 5). The satellite S-band EIRP ranges from 55.6 to 58.2 dBW, and the G/T from 2.8 to 3.8 dB/°K, depending on beam location in the footprint. Four-color frequency reuse maximizes spectrum efficiency. The S-band link characteristics are shown in Table 3.

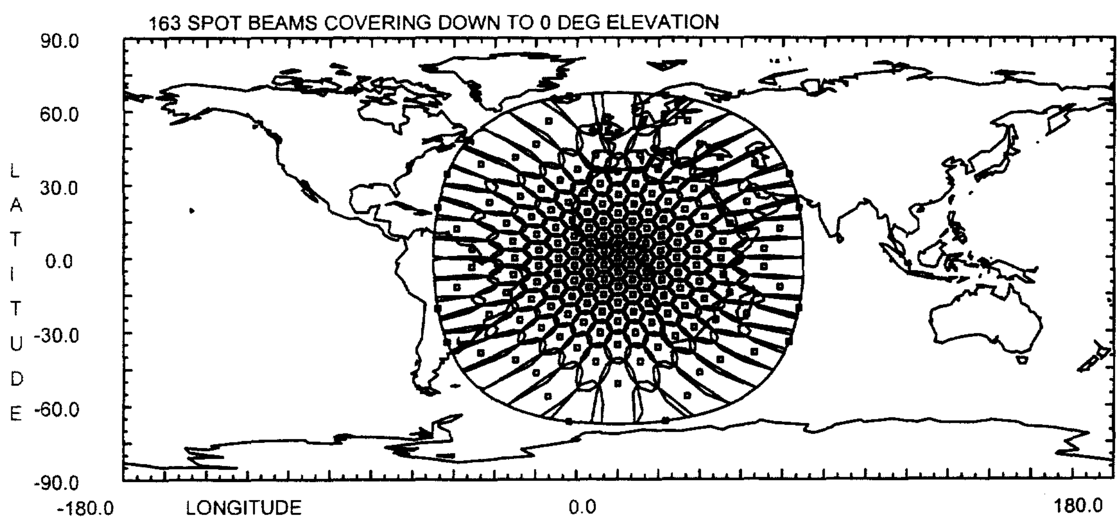

Figure 5. Satellite Beam Positions

Table 3. ICO S-Band Link Characteristics

Parameter	Uplinks	Downlinks
Carrier Spacing	25 kHz	25 kHz
Transmit Power	7 dBW	0.6 dBW
Antenna Gain	0 dBi	33 dBi
Access Technique	FDMA/TDMA	FDMA/TDMA
Burst Rate	36 kbps	36 kbps
Modulation Type	GMSK	QPSK
Out-of-Channel EIRP		
12.5 – 25 kHz offset from center	-18 dBW/4-kHz	8.6 dBW/4-kHz
25 – 62.5 kHz offset from center	-28 dBW/4-kHz	-1.4 dBW/4-kHz
>62.5 kHz offset from center	-43 dBW/4-kHz	-10 dBW/4-kHz
Receiver Minimum G/T	2.8 dB/°K	-23.8 dB/°K
Receiver Bandwidth		
-3 dB	25 kHz	25 kHz
-20 dB	45 kHz	45 kHz
-60 dB	135 kHz	135 kHz
Required Fade Margin	8 dB	8 dB
Required E_b/N_o	1 dB	1 dB
Required C/I	18 dB	18 dB

4.0 The cdma2000 Radio Interface Is Used As A Representative Ancillary Terrestrial Component (ATC)

cdma2000 is a wideband spread spectrum system that uses code division multiple access (CDMA) technology and provides a 3G evolution for systems using the current TIA/EIA-95-B family of standards. RF channel bandwidths of 1.25 MHz and 3.75 MHz are supported at this time but the specification can be extended to bandwidths up to 15 MHz. Detailed technical characteristics are provided in Table 4.

Table 4. cdma2000 Characteristics[1]

Parameter	Mobile	Base
Carrier Spacing	1.25 MHz	1.25 MHz
Transmitter Power	0.1 W	10 W
Antenna Gain	0 dBi	17 dBi
Antenna Height	1.5 m	40 m
Body Loss	0 dB	
Tilt of Antenna		2.5° down
Access Technique	CDMA	CDMA
Data Rates Supported	144 kbps	144 kbps
Modulation Type	QPSK/BPSK	QPSK/BPSK
Out-of-Channel EIRP 700 – 750 kHz offset from center >750 kHz offset from center	 -53.3 dBW/4-kHz -93.5 dBW/4-kHz	 -16.3 dBW/4-kHz -56.5 dBW/4-kHz
Receiver Noise Figure	9 dB	5 dB
Receiver Thermal Noise Level In Bandwidth Equal To Data Rate In Receiver Bandwidth	 -143 dBW -135 dBW	 -147 dBW -139 dBW
Receiver Bandwidth -3 dB -20 dB -60 dB	 1.10 MHz 1.6 MHz 3.7 MHz	 1.10 MHz 1.67 MHz 3.7 MHz
E_b/N_o for $P_e = 10^{-3}$	6.6 dB	6.6 dB
Receiver Sensitivity @ 10^{-3} BER	-137 dBW	-141 dBW
Interference Threshold (Desired Signal At Sensitivity, I/N = -6 dB)	-149 dBW	-153 dBW
Interference Threshold (Desired Signal @ Receiver Sensitivity + 10 dB)	-134 dBW	-138 dBW

5.0 The Satellite Component (SC) and Ancillary Terrestrial Component (ATC) Can Successfully Share Spectrum

There are eight potential interference cases between the SC and ATC. Only four of these are possible for each of the sharing modes as shown in Figure 6. **Analysis is provided showing that in each of these cases, the potential interference can be mitigated to the extent required for successful sharing, provided that a**

[1] FCC Interim Staff Report, "Spectrum Study of the 2500 – 2690 MHz Band – The Potential for Accommodating Third Generation Mobile Systems", 15 November 2000. It is evident from this table that the ATC considered in this sharing analysis uses traditional towers and rooftops as the ATC platform. High Altitude Long Endurance (HALE) platforms are also a promising alternative for ATCs, but would require additional analysis.

<u>single entity has responsibility for the fully integrated operation of the SC and ATC</u>.

	Forward Band	Reverse Band	Downlink Duplex	Uplink Duplex
SC Satellite Into ATC Base		**POTENTIAL**	**POTENTIAL**	
SC Satellite Into UT in ATC Mode	**POTENTIAL**		**POTENTIAL**	
UT in SC Mode Into ATC Base	**POTENTIAL**			**POTENTIAL**
UT in SC Mode Into UT in ATC Mode		**POTENTIAL**		**POTENTIAL**
ATC Base Into SC Satellite		**POTENTIAL**		**POTENTIAL**
ATC Base Into UT in SC Mode	**POTENTIAL**		**POTENTIAL**	
UT in ATC Mode Into SC Satellite	**POTENTIAL**			**POTENTIAL**
UT in ATC Mode Into UT in SC Mode		**POTENTIAL**	**POTENTIAL**	

Figure 6. Potential Interference Cases for Each Mode

5.1. SC Satellite Into ATC Base

This case occurs in the Reverse Band and Downlink Duplex sharing modes.

<u>Analysis</u>

The peak SC Satellite EIRP of 33.6 dBW in a 25 kHz channel at the minimum slant range of 10,390-km results in an interference power at the ATC Base of -146.0 dBW, assuming 0 dBi ATC Base antenna gain in the direction of the SC Satellite. This represents an I/N of -7 dB in the receiver data bandwidth, which would result in an effective 9% reduction in ATC cell size. This almost negligible reduction in ATC cell size would be an acceptable trade for the opportunity to reuse the SC spectrum.

However, up to 44 SC downlink channels could overlap the 1.1-MHz ATC Base receiver bandwidth, increasing the I/N to 9.4 dB. This would reduce the effective ATC cell size by 68%.

Mitigation

The integrated SC Network implements several mitigation techniques to enable effective sharing. First, the ATC Base antennas are designed to minimize gain at angles above the horizon. Proper design practice can provide 25-dB discrimination without sacrificing ATC coverage. This results in a peak ATC Base antenna gain in the direction of the SC satellite of -8 dBi, reducing the I/N per SC downlink channel to -15 dB, and allowing 6 SC downlink channels to overlap the ATC Base receiver bandwidth without significant impact. Even if the entire ATC Base receiver bandwidth were overlapped with SC downlink channels, the resulting impact would only be an I/N of 1.4 dB, reducing the effective ATC cell size by 35%.

Second, the ATC cells are planned to be smaller than would have been possible with exclusive spectrum. Reducing the planned cell size by 35%, in conjunction with the improved ATC Base antenna discrimination, provides sufficient excess margin, even at the edge of coverage, to completely mitigate the potential interference.

Third, the integrated MSS network management system initially assigns non-overlapping spectrum to SC downlinks and to ATC Base receive channels in areas where the SC beams overlap ATC cells. Overlapping channels are only assigned as necessary.

Fourth, the integrated MSS Network management system dynamically controls the number of overlapping channels depending on relative loading of the SC and ATC, and the planned ATC cell size.

The combination of these four techniques, reduced ATC Base antenna sidelobes, planning smaller ATC cells, initially assigning non-overlapping spectrum to SC downlinks and ATC Base receive channels, and dynamically controlling the number of overlapping channels based on relative network loading, **effectively mitigates the potential SC Satellite into ATC Base interference**.

5.2. SC Satellite Into UT in ATC Mode

This case occurs in the Forward Band and Downlink Duplex sharing modes.

Analysis

The peak satellite EIRP of 33.6 dBW in a 25 kHz channel at the minimum slant range of 10,390-km results in an interference power at the UT in ATC mode of -146 dBW, assuming 0 dBi Mobile antenna gain in the direction of the SC Satellite and unobstructed line-of-sight between the UT and the Satellite. This represents an I/N of -11 dB in the receiver data bandwidth, which would result in a 4% reduction in ATC cell size. The almost negligible reduction in ATC cell size would be an acceptable trade for the opportunity to reuse the SC spectrum. However, up to 44 SC downlink channels could overlap the 1.1-MHz receiver bandwidth of the UT in ATC mode, increasing the I/N to 5.4 dB. This would reduce the ATC cell size by 53%.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, the ATC cells are planned to be smaller than would have been possible with exclusive spectrum. Reducing the planned cell size by 53% would provide sufficient excess margin, even at the edge of coverage, to completely mitigate the potential interference.

Second, the integrated network management system initially assigns non-overlapping spectrum to SC downlinks and to receive channels of the UT in ATC mode in areas where the SC beams overlap ATC cells. Overlapping channels are only assigned as necessary.

Third, the integrated MSS Network management system dynamically controls the number of overlapping channels assigned to receivers of UTs in ATC mode and SC downlinks, depending on relative loading of the SC and ATC, and on the planned cell size.

The combination of these three techniques, planning smaller ATC cells, initially assigning non-overlapping channels, and dynamically controlling the number of overlapping channels based on relative loading, **effectively mitigates the potential interference from the Satellite into UTs operating in ATC mode**.

5.3. UT in SC Mode Into ATC Base

This case occurs in the Forward Band and Uplink Duplex sharing modes.

Analysis

The EIRP of UT in SC mode is 7 dBW in a 25 kHz bandwidth, the ATC Base receiver thermal noise power is -139 dBW in a 1.1 MHz bandwidth, and the ATC Base antenna gain is 17 dBi. Thus the required attenuation for an I/N of -6 dB, corresponding to an effective 10% reduction in ATC cell size, is 169 dB. Assuming unobstructed free space propagation, a separation distance of 3362 km would be required. However, the radio horizon for a 40 m high ATC Base antenna in combination with a 2 m high UT antenna is only 32 km. This is the effective limit, a UT in SC mode more than 32 km from an ATC Base will not interfere with it.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, all of the UTs are dual mode, allowing interoperation with the ATC system. Second, the integrated MSS Network management system takes advantage of its knowledge of the ATC Base locations, and the UT locations, to dynamically insure that SC uplink frequency assignments to UTs close enough to an ATC Base and to receive channels of this ATC Base do not overlap.

The combination of these two techniques, requiring that all UTs be dual mode, and dynamically controlling assignments based on UT and ATC Base location, **effectively mitigates the potential for interference from UT in SC mode into ATC Base**.

5.4. UT in SC Mode Into UT in ATC Mode

This case occurs in the Reverse Band and Uplink Duplex sharing modes.

Analysis

The EIRP of a UT in SC mode is 7 dBW in a 25 kHz bandwidth, and the receiver thermal noise power of a UT in ATC mode is -135 dBW in a 1.1 MHz bandwidth. Thus the required attenuation for an I/N of -6 dB, corresponding to an effective 10% reduction in ATC cell size, is 148 dB. Assuming unobstructed free space propagation, a separation distance of 300 km would be required. However, the radio horizon for a 1.5 m high UT in ATC mode antenna in combination with a 2 m high UT in SC mode antenna is only 11 km. This is the effective limit, a UT in SC mode more than 11 km from an UT in ATC mode will not interfere with it.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, all of the UTs are dual mode, allowing interoperation with the ATC system. Second, the integrated MSS Network management system takes advantage of its knowledge of the ATC Base locations, and the UT locations, to dynamically insure that SC uplink frequency assignments to UTs close enough to an ATC Base to interfere with any co-frequency UT in ATC mode operating with that base, and to transmit channels of this ATC Base do not overlap.

The combination of these two techniques, requiring that all UTs be dual mode, and dynamically controlling channel assignments based on UT location, **effectively mitigates the potential interference from a UT in SC mode into a UT in ATC mode**.

5.5. ATC Base Into SC Satellite

This case occurs in the Reverse Band and Uplink Duplex sharing modes.

Analysis

The peak ATC Base EIRP is 27 dBW in a 1.1 MHz bandwidth, equivalent to -33.4 dBW/Hz. The faded EIRP density of a UT in SC mode is -45 dBW/Hz potentially resulting in a C/I of -11.6 dB at the Satellite for each active ATC Base in a Satellite beam.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, the ATC Base antennas are designed to minimize gain at angles above the horizon. Proper design practice can provide 25-dB discrimination without sacrificing ATC coverage. This improves the C/I to 13.4 at the SC Satellite for each active ATC Base in a SC beam.

Second, the SC network management system initially assigns non-overlapping spectrum to SC uplinks and to ATC Base transmit channels in areas where the SC beams overlap ATC cells. Overlapping channels are only assigned as necessary.

Third, the integrated MSS Network management system dynamically controls the number of overlapping channels assigned to SC uplinks and to ATC Base transmit channels, depending on relative loading of the SC and ATC.

Even in the presence of multiple interferers, the combination of these three techniques, reduced ATC Base antenna sidelobes, initially assigning non-overlapping channels, and dynamically controlling the number of overlapping channels based on relative network loading, **effectively mitigates the potential ATC Base into SC Satellite interference**.

5.6. ATC Base Into UT in SC Mode

This case occurs in the Forward Band and Downlink Duplex sharing modes.

Analysis

The peak ATC Base EIRP is 27 dBW in a 1.1 MHz bandwidth, equivalent to a power density of -33.4 dBW/Hz. The faded SC Satellite downlink power flux density at the Earth's surface is -169.7 dBW/Hz/m^2. Assuming unobstructed free space propagation, a separation distance of over 10,000 km would be required to achieve a C/I of 18 dB at the UT. However, the radio horizon for a 40 m high ATC Base antenna in combination with a 2 m high UT in SC mode antenna is only 32 km. This is the effective limit, an ATC Base more then 32 km from a UT in SC mode will not interfere with it.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, all of the UTs are dual mode, allowing interoperation with the ATC system.

Second, the integrated MSS Network management system takes advantage of its knowledge of the ATC Base locations, and the UT locations, to dynamically insure that SC downlink frequency assignments to UTs in SC mode within 32 km of an ATC Base and to transmit channels of this ATC Base do not overlap.

The combination of these two techniques, requiring that all UTs be dual mode, and dynamically controlling channel assignments based on UT location, **effectively mitigates the potential interference from ATC Base into UT in SC mode**.

5.7. UT in ATC Mode Into SC Satellite

This case occurs in the Forward Band and Uplink Duplex sharing modes.

Analysis

> The peak EIRP of a UT in ATC mode is -10 dBW in a 1.1 MHz bandwidth, equivalent to -70.4 dBW/Hz. The faded EIRP density of a UT in SC mode is -45 dBW/Hz resulting in a C/I of 25.4 dB at the Satellite for each active UT in ATC mode in the Satellite beam.

Mitigation

> The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, the integrated MSS Network management system initially assigns non-overlapping spectrum to SC uplink channels to transmit channels of a UT in ATC mode in areas where the SC beams overlap ATC cells. Overlapping channels are only assigned as necessary.
>
> Second, the integrated MSS Network management system dynamically controls the number of overlapping channels assigned to SC uplinks and to transmitters of UTs in ATC mode, depending on relative loading of the SC and ATC networks.

Even in the presence of multiple interferers, the combination of these techniques, assigning channels that do not overlap, and dynamically controlling the number of overlapping channels based on relative network loading, **effectively mitigates the potential interference from a UT in ATC mode into the Satellite.**

5.8. UT In ATC Mode Into UT IN SC Mode

This case occurs in the Reverse Band and Downlink Duplex sharing modes.

Analysis

The peak EIRP of a UT in ATC mode is -10 dBW in a 1.1 MHz bandwidth, equivalent to a power density of -70.4 dBW/Hz. The faded Satellite downlink power flux density at the Earth's surface is -169.7 dBW/Hz/m^2. Assuming unobstructed free space propagation, a separation distance of 206 km would be required to achieve a C/I of 18 dB at the UT in SC mode. However, the radio horizon for a 1.5 m high UT in ATC mode antenna in combination with a 2 m high UT in SC mode antenna is only 11 km. This is the effective limit, a UT in ATC mode more than 11 km from a UT in SC mode will not interfere with it.

Mitigation

The integrated MSS Network implements several mitigation techniques to enable effective sharing. First, all of the UTs are dual mode, allowing interoperation with the ATC system. Second, the integrated MSS Network management system takes advantage of its knowledge of the ATC Base locations, and the UT locations, to dynamically insure that SC downlink frequency assignments to UTs, close enough to an ATC Base to be interfered by any UT in ATC mode operating with this Base, and assignments to receive channels of this ATC Base do not overlap.

The combination of these two techniques, requiring that all UTs be dual mode, and dynamically controlling the channel assignments based on UT location, **effectively mitigates the potential interference from UT in ATC mode into a UT in SC mode**.

6.0 Authorizing The ATC Will Not Increase Interference To MSS Systems Operating In Adjacent Frequency Blocks (AFB) Nor To Services Operating Outside Of The MSS Bands (OOMSSB)

There are four potential interference cases from the ATC of the integrated MSS Network to unrelated MSS systems operating in AFBs. Only two of these are possible for each of the sharing modes as shown in Figure 7. **Analysis is provided showing that in each of these cases, the potential interference in the MSS uplink band from the integrated MSS Network is not increased compared to that from the SC alone, and that the potential interference in the downlink band from the integrated MSS Network is negligible compared to that from OOMSSB services.**

	Compared To	Forward Band	Reverse Band	Downlink Duplex	Uplink Duplex
ATC Base Into AFB Satellite	UT In SC Mode Into AFB Satellite		POTENTIAL		POTENTIAL
ATC Base Into AFB UT	MDS Return Into AFB UT	POTENTIAL		POTENTIAL	
UT In UT Mode Into AFB Satellite	UT In SC Mode Into AFB Satellite	POTENTIAL			POTENTIAL
UT In ATC Mode Into AFB UT	MDS Return Into AFB UT		POTENTIAL	POTENTIAL	

Figure 7. Potential AFB Interference Cases for Each Mode

6.1. ATC Base Into AFB Satellite and Into OOMSSB Services

This case occurs in the Reverse Band and Uplink Duplex sharing modes.

AFB and OOMSSB Interference from SC Component

The peak transmit power of a UT in SC mode is 7 dBW in a 25 kHz bandwidth. For each SC uplink channel, the allowable AFB and OOMSSB emission is -43 dBW/4-kHz at frequency offsets greater than 62.5 kHz.

AFB and OOMSSB Interference from ATC

> The ATC Base transmit spectrum is dynamically assigned within the integrated MSS Network allocated block such that the ATC channel center frequencies are at least 0.75 MHz from the assigned frequency block edge. Thus the peak AFB and OOMSSB emissions from Table 4 are -56.5 dBW/4-kHz. The ATC Base antennas are designed to minimize gain at angles above the horizon. Proper design practice can provide 25-dB discrimination without sacrificing ATC coverage. Hence the peak out-of-block emission in the direction of a MSS satellite is -81.5 dBW/4-kHz.

It is seen that the interference level into the adjacent block SC system from a single ATC Base is 38.5 dB less then that from a single UT in SC mode, therefore 7,000 ATC Bases produce the same interference as a single UT in SC mode. Since the SC can support over 1,000 simultaneous transmissions in the CONUS from UTs in SC mode, this would be equivalent to 7 million ATC Bases. Actually, in any given beam of an affected AFB MSS system there will be a combination of UTs in SC mode and ATC Bases, and the above observations show that **no additional burden is imposed on AFB MSS systems or on OOMSSB services**.

6.2. ATC Base Into AFB UT and Into OOMSSB Services

This case occurs in the Forward Band and Downlink Duplex sharing modes.

AFB and OOMSSB Interference from Other Services

> Emitters operating below 2165 MHz (e.g. transmissions in the MDS return channels operating between 2150 - 2162 MHz) are now authorized to generate an out-of-band power density of -43 dBW/4-kHz across the MSS downlink band allocation and elsewhere outside their authorized bands.

AFB and OOMMSB Interference from ATC

> The ATC Base transmit spectrum is dynamically assigned within the integrated MSS Network assigned frequency block such that the ATC channel center frequencies are at least 0.75 MHz from the block edges. Then the peak AFB and OOMMSB emissions from Table 4 are -56.5 dBW/4-kHz.

It is seen that the AFB and OOMSSB interference levels from an ATC Base are 13.5 dB less than existing emissions from other services. Thus, **no additional burden is imposed on AFB MSS systems or on OOMSSB services**.

6.3. UT In ATC Mode Into AFB Satellite and Into OOMSSB Services

This case occurs in the Forward Band and Uplink Duplex sharing modes.

AFB and OOMSSB Interference from UT In SC Mode

> The peak transmit power of a UT in SC mode is 7 dBW in a 25 kHz bandwidth. From Table 3 the allowable AFB and OOMSSB emissions are -43 dBW/4-kHz per UT in SC mode for frequency offsets greater than 62.5 kHz.

AFB and OOMSSB Interference from ATC

> The transmit spectrum of a UT in ATC mode is dynamically assigned within the integrated MSS Network assigned frequency block such that the ATC channel center frequencies are at least 0.75 MHz from the block edge. Thus the peak AFB and OOMSSB emissions from Table 4 are -93.5 dBW/4-kHz per UT in ATC mode.

It is seen that the interference level into the AFB MSS or OOMSSB system from a single UT in ATC mode is 50.5 dB less than that from a single UT in SC mode, 112,000 UTs in ATC mode produce the same interference as a single UT in SC mode. Since the SC system can support over 1,000 simultaneous transmissions in the CONUS from UTs in SC mode, this would be equivalent to 112 million UTs in ATC mode. Actually, in any given beam of an affected AFB MSS system there will be a combination of UTs in SC mode and UTs in ATC mode, and the above observations show that **no additional burden is imposed on AFB MSS systems or on OOMSSB services**.

6.4. UT In ATC Mode Into AFB MSS UT and Into OOMSSB Services

This case occurs in the Forward Band and Downlink Duplex sharing modes.

AFB and OOMSSB Interference from Other Services

> Emitters operating below the SC downlink band (e.g. transmissions in the MDS return channels operating between 2150 - 2162 MHz) are now authorized to generate an OOMSSB power density of -43 dBW/4-kHz across the MSS downlink band and elsewhere outside their authorized bands.

AFB and OOMSSB Interference from ATC

> The transmit spectrum of a UT in ATC mode is dynamically assigned within the integrated MSS Network allocated block such that the ATC channel center frequencies are at least 0.75 MHz from the assigned block edge. Then the peak AFB and OOMSSB emissions from Table 4 are -93.5 dBW/4-kHz.

It is seen that the AFB and OOMSSB interference levels from a UT in ATC mode are 50.5 dB less than those from existing emissions from other services. Thus, **no additional burden is imposed on AFB MSS systems or on OOMSSB services**.

C

APPENDIX C:
[Proposed] Amendments to 2 GHz MSS Service Rules

Proposed Rule Revisions

Title 47 of the Code of Federal Regulations, Part 25, is amended as follows:

1. Section 25.114 is amended by revising paragraph (c) to read as follows:

Section 25.114 Applications for space station authorizations.

* * * * *

(c) The following information in narrative form shall be contained in each application:

* * *

(6) * * *

(iv) if applicable, the complete radio frequency plan for any ancillary terrestrial component that may be proposed for incorporation into a GHz Mobile-Satellite Service network, together with a demonstration that use of such ancillary terrestrial component will not cause harmful interference to other authorized users in adjacent bands;

* * *

* * * * *

2. Section 25.143 is amended by adding new paragraph (*i*) to read as follows:

Section 25.143 Licensing provisions for the 1.6/2.4 GHz mobile-satellite service and 2 GHz mobile-satellite service.

* * * * *

(*i*) *Licensing of the 2 GHz Mobile-Satellite Service Ancillary Terrestrial Component*: Any applicant authorized to construct and launch a 2 GHz Mobile-Satellite System may construct and operate an ancillary terrestrial component of an integrated 2 GHz Mobile-Satellite Service network. The ancillary terrestrial component may re-use terrestrially whatever frequencies have been assigned to the 2 GHz Mobile-Satellite Service operator for space-to-Earth and Earth-to-space Mobile-Satellite Service transmissions. No such ancillary terrestrial component shall be placed in operation until the space stations in the integrated 2 GHz Mobile-Satellite Service network have been placed in commercial service.

* * *

3. Section 25.201 is amended by amending the following definition in alphabetical order to read as follows:

Section 25. 201 Definitions.

* * * * *

2 GHz Mobile-Satellite Service. A mobile-satellite service (together with any ancillary terrestrial component of such service) that operates in the 1990-2025 MHz and 2165-2200 MHz frequency bands, or in any portion thereof.

* * * * *